

Claims

We claim:

- 1     1.     A method of cooling at least one heat-generating device using a cooling system, the  
2           method comprising the steps of:  
3           using at least one pump to cause a fluid to flow in at least one heat exchanger; and  
4           adjusting a pressure of the fluid to correspondingly adjust a boiling  
5           point temperature of the fluid in the at least one heat exchanger.
  
- 1     2.     The method of claim 1, wherein the step of adjusting a pressure of the fluid comprises  
2           adjusting operating conditions of the at least one pump in response to at least one of:  
3                 changes in pressure of the fluid;  
4                 changes in temperature of the fluid;  
5                 changes in temperature of the at least one heat-generating device; and  
6                 changes in temperature of the at least one heat exchanger.
  
- 1     3.     The method of claim 1, wherein the step of adjusting a pressure of the fluid comprises  
2           adjusting an orifice coupled to the at least one heat exchanger in response to at least one  
3           of:  
4                 changes in pressure of the fluid;  
5                 changes in temperature of the fluid;  
6                 changes in temperature of the at least one heat-generating device; and  
7                 changes in temperature of the at least one heat exchanger.
  
- 1     4.     The method of claim 1, wherein the method further comprises the step of: providing at  
2           least one heat rejector for rejecting heat from the system to ambient air, the at least one

- 3           heat rejector being situated downstream of the at least one heat exchanger.
- 1       5.     The method of claim 4, wherein the method further comprises the step of providing a  
2           reservoir that accommodates a larger volume of a gas in the system generated during  
3           boiling.
- 1       6.     The method of claim 5, wherein the reservoir reduces a change in pressure of the fluid  
2           that occurs during boiling.
- 1       7.     The method of claim 5, wherein the reservoir is situated downstream of the at least one  
2           heat rejector..
- 1       8.     The method of claim 5, wherein the reservoir is situated upstream of the at least one heat  
2           rejector.
- 1       9.     The method of claim 5, wherein the reservoir having a volume region as great as the  
2           volume of vapor generated by the at least one heat exchanger during boiling of the fluid.
- 1       10.    The method of claim 5, wherein the reservoir having an inlet coupled to a fluid outlet port  
2           of the at least one heat rejector via a first portion of a fluid transport line and an outlet  
3           coupled to a fluid inlet port of the at least one pump via a second portion of the fluid  
4           transport line.
- 1       11.    The method of claim 5, wherein the reservoir is integrated with one of the at least one  
2           heat rejector and the at least one pump.
- 1       12.    The method of claim 1, wherein the system is hermetically sealed.

- 1     13.     The method of claim 12, wherein the hermetically sealed refers to a design in which the  
2             pressure under a given set of pump, ambient temperature, and heating conditions varies  
3             by less than 1 psi during a five year lifetime.
- 1     14.     The method of claim 1, wherein the fluid is selected from a group consisting of water,  
2             acetonitrile, acetone, N-methylformamide, benzene, ethanol, methanol, and a  
3             combination thereof.
- 1     15.     The method of claim 1, wherein the fluid comprises a halocarbon.
- 1     16.     The method of claim 15, wherein the halocarbon is a methane series halocarbon selected  
2             from the group consisting of trichlorofluoromethane and trifluoromethane.
- 1     17.     The method of claim 15, wherein the halocarbon is a ethane series halocarbon comprising  
2             pentafluoroethane (R-125).
- 1     18.     The method of claim 1, wherein the fluid is a zeotropic blend comprising R-404A.
- 1     19.     The method of claim 1, wherein the fluid is an azeotropic blend selected from the group  
2             consisting of R-500 and R-502.
- 1     20.     The method of claim 1, wherein the fluid is inorganic.
- 1     21.     The method of claim 20, wherein the inorganic is selected from the group consisting of  
2             ammonia and carbon dioxide.

- 1      22.    The method of claim 1, wherein the fluid comprises a hydrocarbon.
- 1      23.    The method of claim 22, wherein the hydrocarbon is selected from the group consisting  
2           of methane, ethane, propane, n-butane, 2-methylpropane, isobutane, ethene, ethylene,  
3           propene, propylene, and combinations thereof.
- 1      24.    The method of claim 1, wherein the fluid is cryogenic.
- 1      25.    The method of claim 24, wherein the cryogenic is selected from the group consisting of  
2           hydrogen, parahydrogen, helium, nitrogen, neon, air, oxygen, argon, and combinations  
3           thereof.
- 1      26.    The method of claim 1, wherein the fluid is selected from the group consisting of water,  
2           acetonitrile, acetone, N-methylformamide, benzene, ethanol, methanol, halocarbons,  
3           zeotropic blends, azeotropic blends, inorganic fluids, hydrocarbons, cryogenic fluids, and  
4           mixtures thereof, the halocarbons being methane series halocarbons selected from the  
5           group consisting of trichlorofluoromethane, trifluoromethane and mixtures thereof, the  
6           zeotropic blends comprising R-404A, the azeotropic blends being selected from the group  
7           consisting of R-500, R-502 and mixtures thereof, the inorganic fluids being selected from  
8           the group of ammonia, carbon dioxide and mixtures thereof, the hydrocarbons being  
9           selected from the group consisting of methane, ethane, propane, n-butane, 2-  
10          methylpropane, isobutane, ethene, ethylene, propene, propylene and mixtures thereof, the  
11          cryogenic fluids being selected from the group consisting of hydrogen, parahydrogen,  
12          helium, nitrogen, neon, air, oxygen, argon and mixtures thereof.
- 1      27.    The method of claim 1, wherein the method further comprises the step of: providing  
2           sensors to adjust the fluid flow from the at least one pump.

- 1     28.    The method of claim 27, wherein the sensors being coupled to the at least one heat  
2            exchanger.
- 1     29.    The method of claim 1, wherein the at least one pump is electro-osmotic.
- 1     30.    The method of claim 1, further comprising the step of: delivering to a catalytic  
2            recombiner a gaseous stream containing hydrogen being discharged from a downstream  
3            side of the at least one pump together with an amount of oxygen generated from an  
4            upstream side of the at least one pump sufficient to convert the hydrogen and oxygen to  
5            water, the catalytic recombiner coupled to an inlet port of the at least one pump.
- 1     31.    The method of claim 1, wherein the step of adjusting a pressure of the fluid comprises  
2            adjusting the pressure of the fluid during a charging and sealing of the system.
- 1     32.    The method of claim 1, wherein the step of adjusting a pressure of the fluid comprises  
2            adjusting at least one of a composition and volume and combinations thereof of at least  
3            one of a gas and liquid and combinations thereof introduced during charging of the  
4            system.